

11.2 Second Voice Melody

Features

- Operating frequency: 1024kHz
- Operating voltage: 2.4V~5.0V
- 16 key and 4 bank selection
- Low standby current (1μA for Typ. VDD=3V)
- 2 channels of melody and one channel of voices
- Minimal external components
- 32 tempos, 14 beats and 4 octaves of melody playing
- 11.2 seconds of voice capacity (based on a sampling rate of about 6kHz)
- 4096 melody notes maximum
- 8 programmable voice sampling rates
- Programmable key debounce time and pull-high resistors
- Key options:
 - Retriggerable/non-retriggerable (for all keys)
 - Level hold (for all keys)
 - Repeat (for all keys)
 - Sequential playing (only for KEY1)
- FLAG options:
 - Busy output
 - 4Hz flash output
 - End-pulse output
 - Volume level display
- 28 DIP/SOP package

Applications

- Toys
- Alarm clocks
- Voice effect generators
- Other products with a voice interface

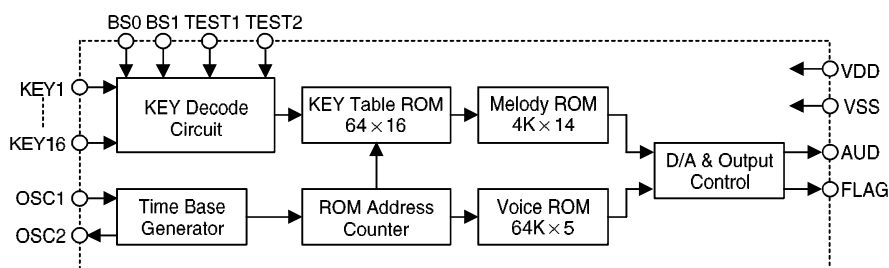
General Description

The HT3894 is a single chip melody and voice synthesis IC implemented in the CMOS technology. It includes an on-chip voice and melody ROM for storing data, a key ROM of key address pointers, and a current type of D/A converter for driving an external transistor. All elements are prepared for fabrication except the key option and ROM data. The customer's key function, voice, and melody data are all

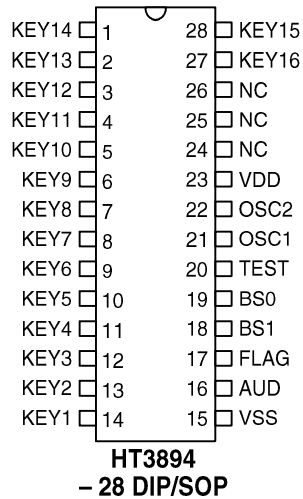
programmable by changing a layer of the masked ROM.

The HT3894 provides 16 key inputs along with 4 banks of key functions. Each bank stores a set of key functions corresponding to KEY1~KEY16, giving the customer a full range of 64 key functions available.

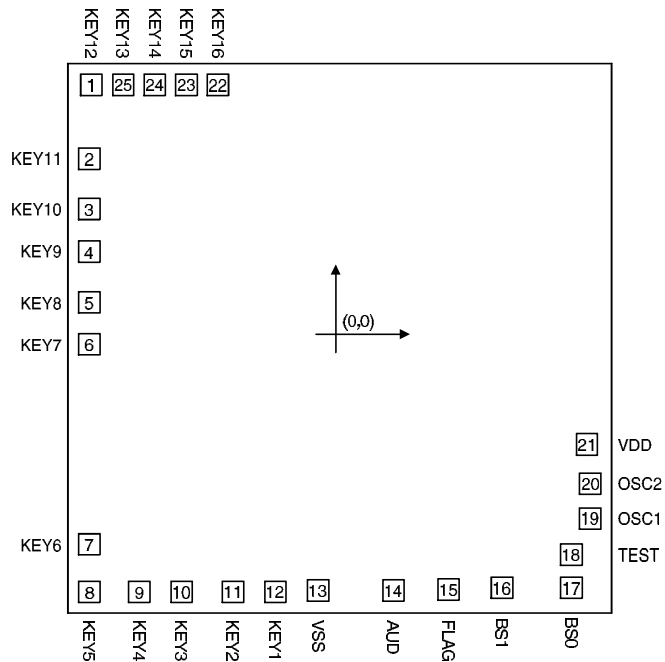
Block Diagram



Pin Assignment



Pad Coordinates



* The IC substrate should be connected to VSS in the PCB layout artwork.

Pad Assignment

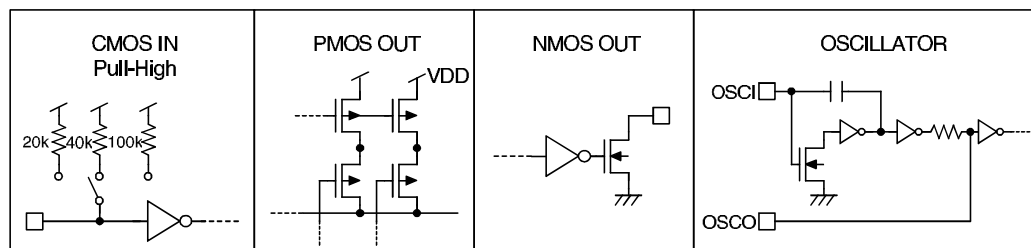
Unit: μm

Pad No.	X	Y	Pad No.	X	Y
1	-1298.10	1322.30	14	307.00	-1361.90
2	-1309.90	930.80	15	598.90	-1356.90
3	-1309.90	662.10	16	882.80	-1346.90
4	-1309.90	437.30	17	1250.70	-1346.90
5	-1309.90	168.60	18	1250.70	-1171.90
6	-1309.90	-56.20	19	1349.90	-980.40
7	-1309.90	-1116.50	20	1349.90	-795.40
8	-1309.90	-1368.90	21	1332.50	-586.40
9	-1043.50	-1368.90	22	-626.00	1322.30
10	-818.70	-1368.90	23	-794.00	1322.00
11	-546.50	-1368.90	24	-962.00	1322.00
12	-321.70	-1368.90	25	-1129.70	1322.30
13	-94.10	-1361.40			

Pad Description

Pad No.	Pad Name	I/O	Internal Connection	Description
1~9,12, 22~25	KEY12~KEY4, KEY1, KEY16~KEY11	I	Pull-High	Trigger key, active low (refer to the functional description)
10,11	KEY3,KEY2	I/O	Pull-High	Trigger key, active low Outputs mode for IC test only.
13	VSS	I	—	Negative power supply (GND)
14	AUD	O	PMOS	Voice output for driving an external transistor
15	FLAG	O	NMOS	Active low, programmable display mode (refer to the functional description)
16,17	BS1,BS0	I	Pull-High (push button selection mode) or Floating (Two switch selection mode)	Selection of 4 banks (BANK0~BANK3) of key functions is provided. Each bank stores a set of key functions corresponding to KEY1~KEY16. There are two kinds of bank selection modes to be selected by mask option. (refer to the functional description) Mode 1: BS0 push button selection mode (BS1 not used) Mode 2: BS0/BS1 two switch selection mode
18	TEST	I	Pull-High	For IC test only
19	OSC1	I	—	Oscillator input pin
20	OSC2	O	—	Oscillator output pin
21	VDD	I	—	Positive power supply

Approximate internal connection circuit



Absolute Maximum Ratings*

Supply Voltage -0.3V to 6V

Input Voltage..... VSS-0.3V to VDD+0.3V

Storage Temperature..... -50°C to 125°C

Operating Temperature..... -20°C to 70°C

*Note: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

(Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.4	3	5	V
I _{DD}	Operating Current	3V	No load F _{OSC} =1024kHz	—	500	1000	μA
I _{STB}	Standby Current	3V	—	—	1	3	μA
I _{AUD}	Max. AUD Output Current	3V	V _{OH} =0.6V	-1.5	-2	—	mA
R _{PH1}	Input Pull-High Resistance	—	—	10	20	30	kΩ
R _{PH2}	Input Pull-High Resistance	—	—	20	40	60	kΩ
R _{PH3}	Input Pull-High Resistance	—	—	50	100	150	kΩ
I _{OL}	FLAG Sink Current	3V	V _{OL} =0.3V	2.5	5	—	mA
V _{IH}	“H” Input Voltage	—	—	0.8V _{DD}	—	V _{DD}	V
V _{IL}	“L” Input Voltage	—	—	0	—	0.2V _{DD}	V
F _{OSC}	System Frequency	3V	*R _{OSC} =37kΩ	920	1024	1150	kHz

* The user can select the resistance between 43kΩ to 36kΩ to match the frequency.

Functional Description

The HT3894 is a single chip melody and voice synthesizer. It is equipped with a 11.2 second voice capacity at a 6kHz sampling rate. The HT3894 can program a maximum of 4096 notes for melody composition.

The IC provides 16 key inputs (KEY1~KEY16), 4 banks of key functions, and a FLAG output.

Programming

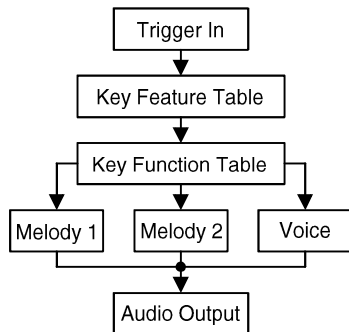
HOLTEK's engineers will edit the sources, compose the melodies with CAD tools and verify the result in an EV (evolution) board after receiving the customer's voice/melody sources (recorded audio tapes, CDs, or other media) and key function specifications. Then, the edited codes will

be recorded into a voice ROM by programming a layer of the mask.

Play

The functions of each key specified by the customer are recorded in the key function table. A group of sections and melodies is played according to the instructions of the key function table each time the chip receives a key trigger input.

Trigger signal flow



KEY1~KEY16

The HT3894 provides 16 key inputs (KEY1~KEY16) along with 4 banks of key functions, giving the customer a full range of 64 different key inputs. KEY1~KEY16 are all trigger keys. The 64 different key inputs can be independently programmed as follow:

- retriggerable
- non-retriggerable
- repeat
- level hold trigger key

But KEY1 alone can be set as a sequential key.

The key-in pull-high resistors are selected by mask option, namely

- 20kΩ
- 40kΩ
- 100kΩ

The key debounce time is also selected by mask option as shown.

- 0 ms for KEY16 only
- 700 μs for all KEYs
- 22 ms for all KEYs
- 45 ms for all KEYs
- 90 ms for all KEYs

The key priority is as follows.

KEY1>KEY2>.....>KEY15>KEY16

Bank selection

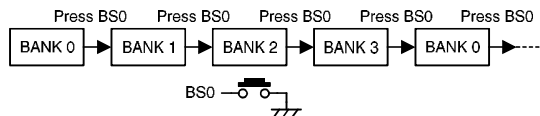
The HT3894 provides 4 banks of key functions. Each bank can be programmed and stores a set

of key functions corresponding to KEY1~KEY16. The voices of a bank comes into play each time a key of KEY1~KEY16 is triggered. A maximum of 4 kinds of voices can be played by selecting different banks of the same key. The total amount of key inputs is 64.

There are two kinds of bank mode to be selected by mask option.

- Mode 1: BS0 push button selection mode (BS1 not used)

The bank number beginning at BANK0 is increased by one each time BS0 is pressed. The banks are selected in the following way.

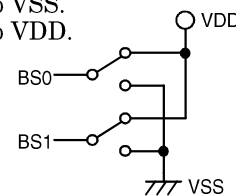


- Mode 2: BS0 and BS1 two switch selection mode

In Mode 2, banks are selected in the following way.

BANK KEY	BANK 0	BANK 1	BANK 2	BANK 3
BS0	1	0	1	0
BS1	1	1	0	0

Note: 0: Connect to VSS.
1: Connect to VDD.

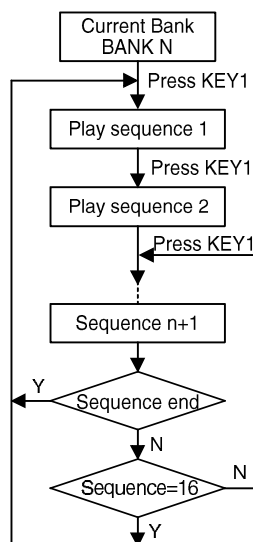


Bank function

Selection of either sequence bank or direct bank can be made if KEY1 is set as a sequential key and the mode of bank selection is in the push button mode. But if the mode of bank selection is in the 2 switch mode, only the direct bank can be chosen.

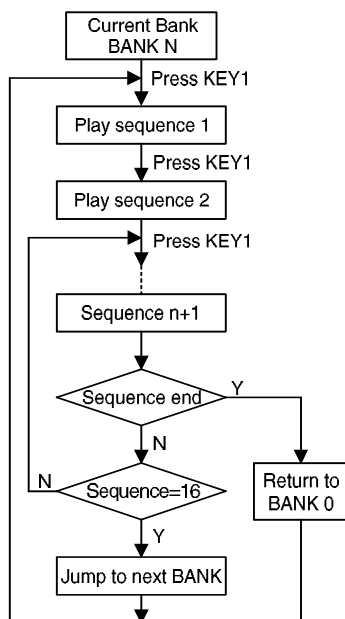
- Direct bank

The 4 banks of key functions are independent when the direct bank operation is selected. In other words, the sequential cycle of KEY1 can be 16 at maximum.



• **Sequence bank**

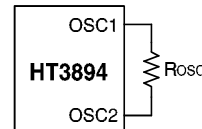
The 4 banks of key functions are all cascaded when the sequence bank operation is selected. That is to say, the sequential cycle of KEY1 can be 64 maximum.



Oscillator

The HT3894 is built-in with an RC oscillator which requires only one external resistor for normal applications.

The oscillator is turned off when the system is in the standby state. The following diagram demonstrates the way of connecting the circuit:

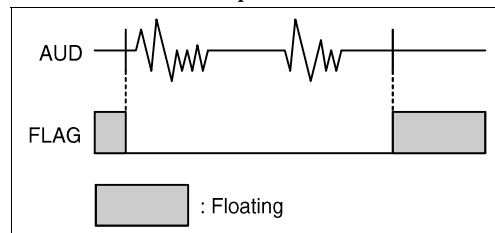


FLAG output

The FLAG pin can be programmed by mask option, giving one of the following functions:

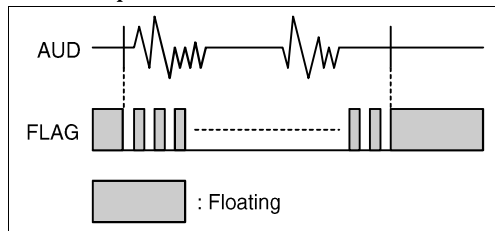
• **Busy output**

The FLAG pin turns low and the FLAG LED switches on when a voice output occurs. It becomes floating and the FLAG LED switches off once the voice output is terminated.



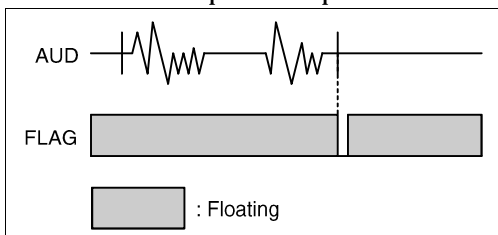
• **4Hz flash output**

The FLAG LED flashes at a 4Hz rate, and the LED turn-on duty is 25% when there are voices output.



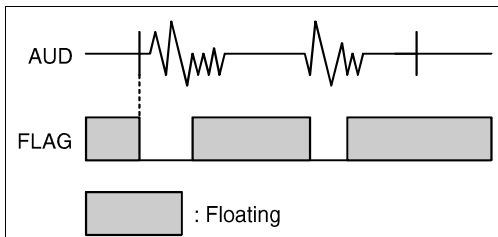
• **End-pulse output**

The FLAG pin outputs an active low pulse when the voice output is completed.



• **Volume level display**

The brightness of LED varies with the volume.



Melody output

There are 32 tempos, 4 octaves, and 14 beats of melody outputs and four kinds of envelope decay to be selected as shown.

• **32 tempos (Beats/Min)**

60.98	62.50	65.79	69.44	73.55
78.125	83.33	86.21	89.29	92.59
96.15	100	104.17	108.70	113.64
119.05	121.95	125	131.58	138.89
147.06	156.25	166.67	172.41	178.57
185.19	192.31	200	208.33	217.39
227.27	238.10			

• **4 octaves**

C1[#]~C2, C2[#]~C3, C3[#]~C4, C4[#]~C5

• **14 beats**

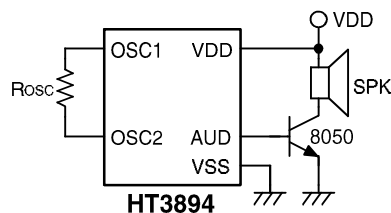
0, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, 2, 3, 4, 5

• **Envelope decay**

The envelope decay decides the melody output decay time. It provides four kinds of envelope decay (Fast, Middle, Slow, Slowest) by mask option.

AUD

The AUD pin is a PMOS open drain structure. It outputs voice signals to drive a speaker through an external NPN transistor when the chip is active. Once the chip is in the standby state, this pin turns out floating.



Mask option

- Key options: Retriggerable/non-retriggerable/Level hold/Repeat (Sequential playing only for KEY1)
- FLAG options: Busy/4Hz flash/End-pulse/Volume level display
- Envelope decay rate: Fast/Middle/Slow/Slowest
- Pull-high resistor: 20kΩ/40kΩ/100kΩ
- Key debounce time: 700μs/22ms/45ms/90ms (0μs only for key16)

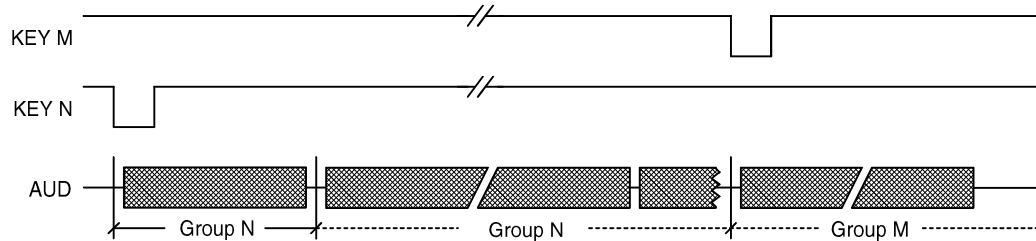
Mask Option of KEY1~KEY16

Function KEY	Sequential Key	Retrigger & Repeat	Retrigger & Non-Repeat	Non-Retrigger	Level Hold	Debounce Time					Pull-High Resistor		
						0	700μs	22ms	45ms	90ms	20kΩ	40kΩ	100kΩ
KEY1	—					—							
KEY2													
KEY3													
KEY4													
KEY5													
KEY6													
KEY7													
KEY8													
KEY9													
KEY10													
KEY11													
KEY12													
KEY13													
KEY14													
KEY15													
KEY16													

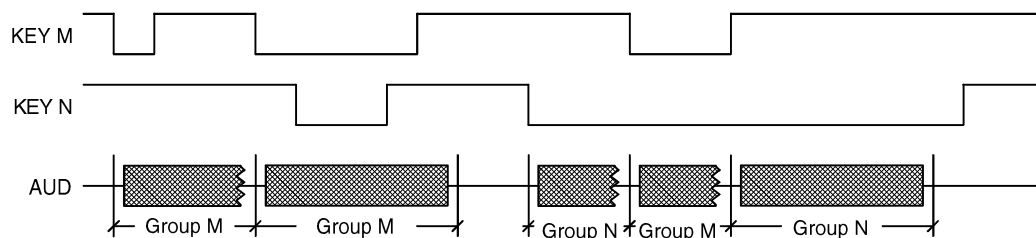
Note: The 16 keys (KEY1~KEY16) of 4 BANKs can be optioned as retriggerable/
non-retriggerable, level hold, or repeat trigger mode independently.
"—": means "not applicable".

Timing Diagram

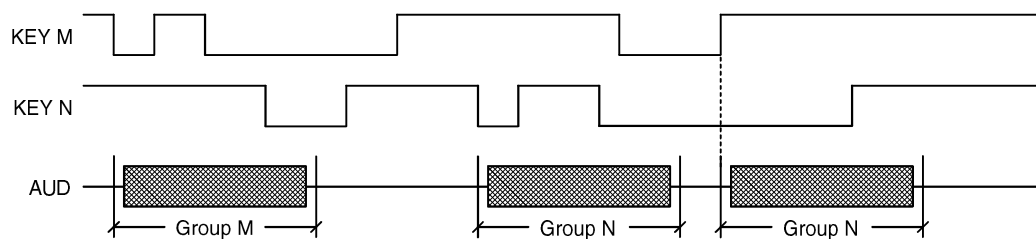
Retriggerable & repeat



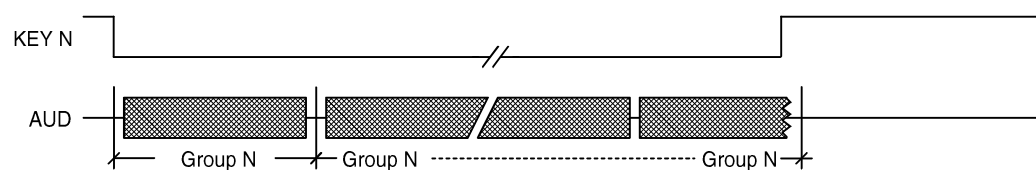
Retriggerable & non-repeat



Non-retriggerable



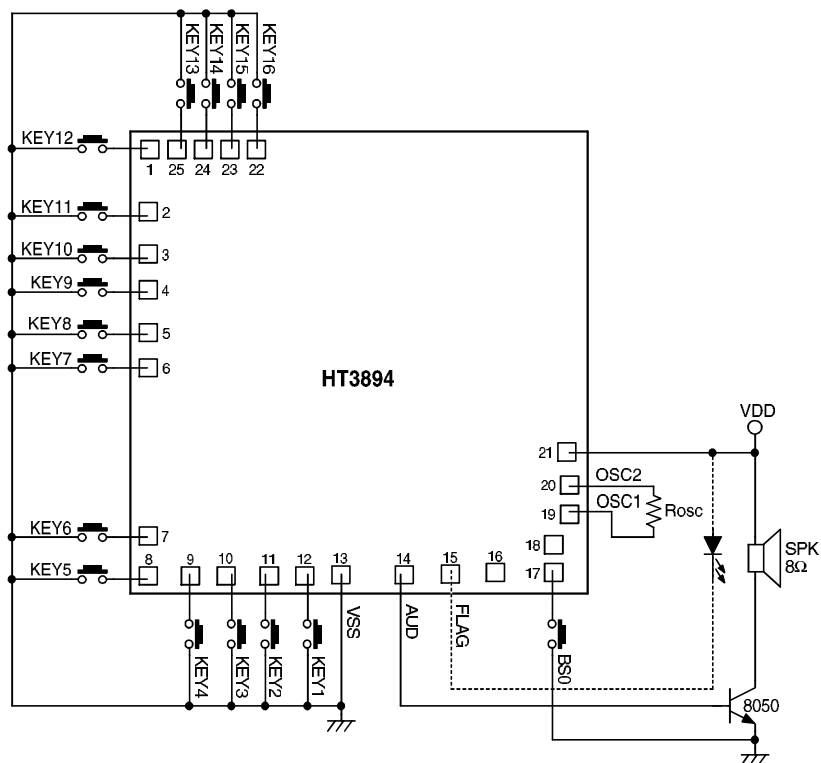
Level-hold



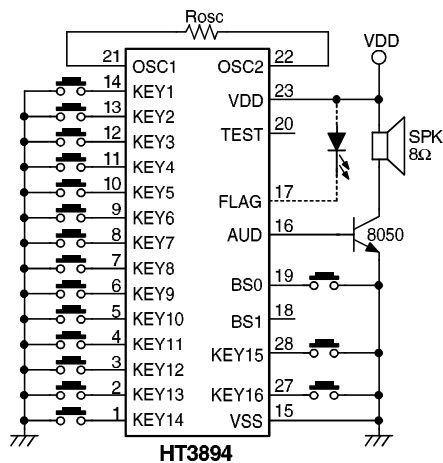
Note: The key priority: KEY M > KEY N

Application Circuits

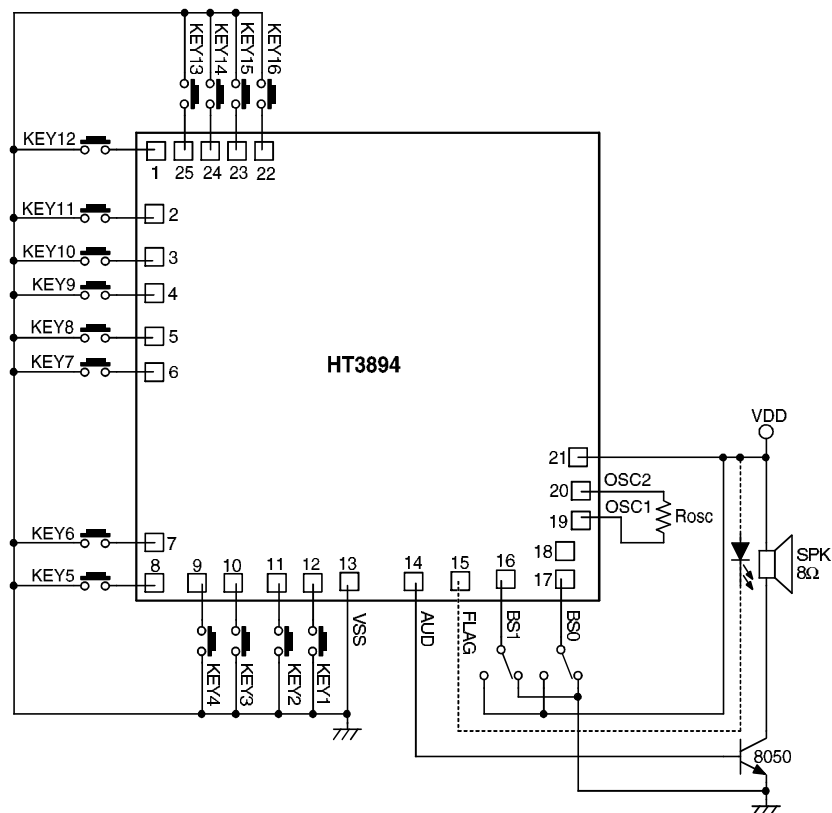
MODE 1: BS0 push button bank selection mode



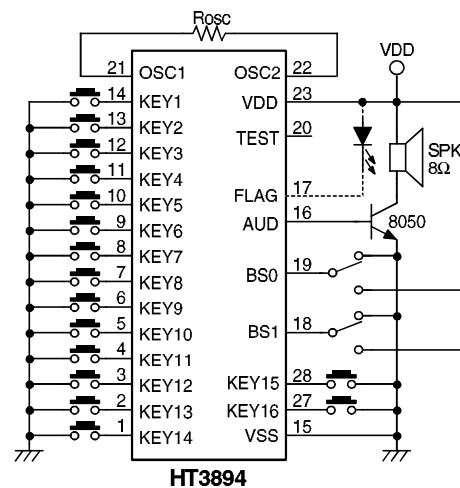
* The IC substrate should be connected to VSS in the PCB layout artwork.



MODE 2: BS0 and BS1 two switch bank selection mode



* The IC substrate should be connected to VSS in the PCB layout artwork.



Standard Item List
HT3894A (Melody voice for child song)

BANK0	KEY Name
KEY1	Picnic
KEY2	Stagecoach
KEY3	Music Box Dancer
KEY4	It Is A Small World
KEY5	The Old Folks At Home
KEY6	Oh, Susannah
KEY7	Cuckoo Waltz
KEY8	Old Macdonald Had A Farm
KEY9	The Yellow Rose Of Texas
KEY10	The More We Get Together
KEY11	Green Sleeves
KEY12	Rock A Bye Baby
KEY13	I Am So Happy
KEY14	Buttons And Bows
KEY15	Romance De Amor
KEY16	Twinkle Twinkle Little Star

BANK1	KEY Name
KEY1	Turkey In The Straw
KEY2	London Bridge Is Falling Down
KEY3	I Am A Little Teapot
KEY4	If You Are Happy
KEY5	Moonlight On The Colorado
KEY6	Song Of Joy
KEY7	Home On The Range
KEY8	Cardle Song
KEY9	Landler Tanz
KEY10	Mary Had A Little Lamb
KEY11	Yankee Doodle

BANK1	KEY Name
KEY12	The Redder
KEY13	For Elise
KEY14	Happy Birthday To You
KEY15	Row Row Row Your Boat
KEY16	Are You Sleeping

BANK2	KEY Name
KEY1	So5
KEY2	Fa5
KEY3	Mi5
KEY4	Re5
KEY5	Do5
KEY6	Si4
KEY7	La4
KEY8	So4
KEY9	Fa4
KEY10	Mi4
KEY11	Re4
KEY12	Do4
KEY13	Si3
KEY14	La3
KEY15	So3
KEY16	Fa3

BANK3	KEY Name
KEY1	Crash Cymbal
KEY2	Brush
KEY3	Clap
KEY4	Horse
KEY5	Cuckoo
KEY6	Bird

BANK3	KEY Name
KEY7	Sheep
KEY8	Dog
KEY9	Cat
KEY10	Duck
KEY11	Horse Step
KEY12	Laughing
KEY13	Hello
KEY14	Carbell
KEY15	Borning
KEY16	Whistle

Notes: Pull-high resistor: 100K
 Key option: All keys are retriggerable
 Flag display: 4Hz flash
 Bank selection: Switch selection

HT3894B (4 Animals)

BANK0	KEY Name
KEY1	Cat "Miaowing"
KEY2	Cat "Miaowing" Twice
KEY3	Jesus Loves Me
KEY4	Holy Night
KEY5	Winter Wonderland
KEY6	Hark! The Herald Angels Sing
KEY7	Jingle Bells
KEY8	Deck The Halls
KEY9	The First Noel
KEY10	Joy To The World
KEY11	Santa Claus Is Coming To Town
KEY12	Rudolp, The Red-Nosed Reindeer

BANK1	KEY Name
KEY1	Dog "Barking"
KEY2	Dog "Barking" Twice
KEY3	Mary Had A Little Lamb
KEY4	Go Tell Aunt Rbody
KEY5	Oh, Susanna
KEY6	This Old Man
KEY7	Lightly Row
KEY8	Happy Cha Cha Cha
KEY9	Old Macdonald Had A Farm
KEY10	London Bridge Is Falling Down
KEY11	Rain Day
KEY12	Bingo

BANK2	KEY Name
KEY1	Sheep "Baaing"
KEY2	Sheep "Baaing" Twice
KEY3	Home Sweet Home
KEY4	Cradle Song
KEY5	Long, Long Ago
KEY6	Goodye Song
KEY7	Fur Elise
KEY8	Minuet
KEY9	The Battle Of Waterloo
KEY10	Peter And Wolf
KEY11	L'Arlesienne
KEY12	A Maiden's Prayer

BANK3	KEY Name
KEY1	Sea Lion "Barking"
KEY2	Sea Lion "Barking" Twice
KEY3	Song Of Joy

BANK3	KEY Name
KEY4	Camptown Races
KEY5	Kon Kon Dance
KEY6	The Caissons Go Rolling Along
KEY7	Billy Boy
KEY8	Old Black Joe
KEY9	She'll Be Coming Round The Mountain
KEY10	When The Saints Go Marching In
KEY11	Three Blind Mice
KEY12	Turkey In The Straw

Notes: Pull-high resistor: 100K
 Key option: All keys are retriggerable
 Flag display: Busy output
 Bank selection: Switch selection

HT3894C (Guitar Session)

BANK0	KEY Name
KEY1	London Bridge Is Falling Down (One Key Sequential)
KEY2	Do
KEY3	Re
KEY4	Mi
KEY5	Fa
KEY6	So
KEY7	La
KEY8	Si
KEY9	.Do
KEY10	Solo1
KEY11	Solo2
KEY12	Solo3
KEY13	Solo4
KEY14	Solo5
KEY15	Solo6
KEY16	Solo7

BANK1	KEY Name
KEY1	Camptown Races (One Key Sequential)
KEY2	Do
KEY3	Re
KEY4	Mi
KEY5	Fa
KEY6	So
KEY7	La
KEY8	Si
KEY9	.Do
KEY10	Home On The Range
KEY11	If You Are Happy
KEY12	Stagecoach
KEY13	Turkey In The Straw
KEY14	Oh, Susanna!
KEY15	Old Macdonald Had A Farm
KEY16	The Yellow Rose Of Texas

BANK2	KEY Name
KEY1	Little Brown Jug (One Key Sequential)
KEY2	Do
KEY3	Re
KEY4	Mi
KEY5	Fa
KEY6	So
KEY7	La
KEY8	Si
KEY9	.Do
KEY10	Rhythm1 (repeat 4)
KEY11	Rhythm2 (repeat 4)
KEY12	Rhythm3 (repeat 4)
KEY13	Rhythm4 (repeat 4)

BANK2	KEY Name
KEY14	Rhythm5 (repeat 4)
KEY15	Rhythm6 (repeat 4)
KEY16	Rhythm7 (repeat 4)

BANK3	KEY Name
KEY1	Are You Sleeping (One Key Sequential)
KEY2	Do
KEY3	Re
KEY4	Mi
KEY5	Fa
KEY6	So
KEY7	La
KEY8	Si
KEY9	.Do
KEY10	Bingo
KEY11	I've Been Working On The Railroad
KEY12	She'll Be Coming Round The Mountain
KEY13	Joyous Farmer
KEY14	Pop! Goes The Weasel
KEY15	Bow Belinda
KEY16	Dixie

Notes: Pull-high resistor: 100K

Key option: Bank0 defines as Retriggerable and Non-repeat from KEY1 to KEY9 and others are level hold. On others Banks define as retriggerable and non-repeat for all keys. And the KEY1 on all Banks set as sequential key.

Flag display: Sound level

Bank selection: Push button selection